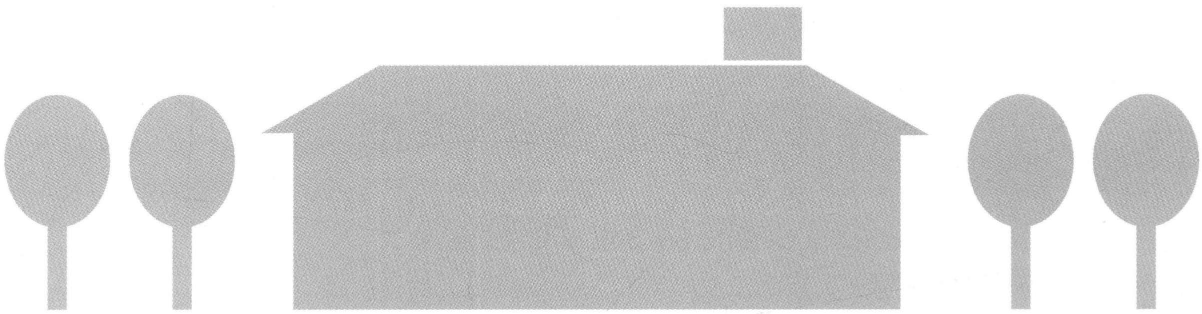
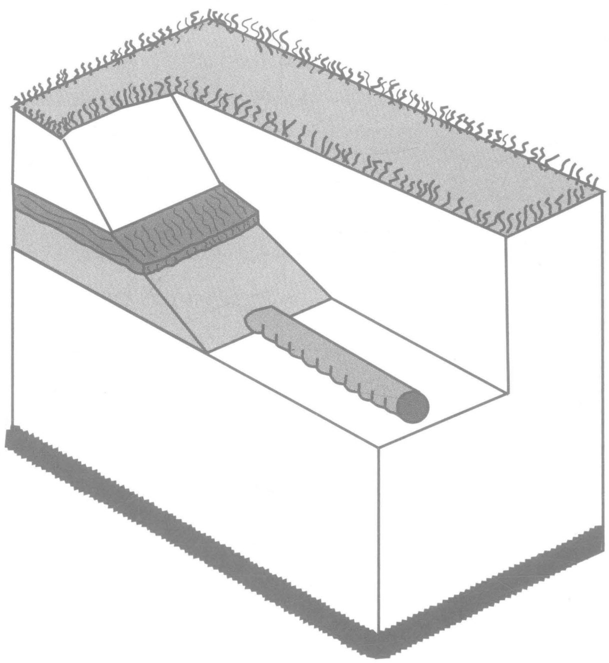
Bulletin 896

Suitability of Ohio Soils for Treating Wastewater





THE OHIO STATE UNIVERSITY EXTENSION

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Suitability of Ohio Soils for Treating Wastewater

In Ohio, almost one million homes are beyond the reach of community sewage systems (Bureau of Census 1990). Each year many more homes are built in rural Ohio and all must consider treating and disposing of wastewater on the lot. The soil on the lot is often considered the best medium to treat and dispose of the wastewater to protect the health of the family, neighbors, and visitors as well as the environment that all Ohioans treasure.

Ohio has wonderfully diverse soil resources. Each of Ohio's nearly 500 soil series have been characterized by the National Cooperative Soil Survey. Tabulated and assessed by a group of soil scientists, the soil depth to bedrock, depth to a limiting soil condition, depth to seasonal saturation, and soil permeability are just some of the characteristics described in 88 individual county soil surveys.

Onsite sewage treatment system designers, planners, installers, and regulators all can use this valuable information to help select the most appropriate wastewater treatment and disposal systems for a tract of land. Of course, soil is usually not present in the landscape in discrete units, but rather as a continuous pattern of gradually varying conditions and capabilities to renovate sewage effluents. The soil maps presented in soil surveys, therefore, serve as a guide to help assess the extent and diversity of the soil resource but do not aim to delineate short-range variations in soil attributes. Before an individual system is sited and designed, a detailed site and soil assessment must be conducted to gain understanding of specific local conditions.

The soil's ability to purify wastewater has been recognized for decades. The goal in any sewage treatment system is to remove pollutants such as disease-causing organisms, ammonia, organic matter, and solids, before the wastewater reaches ground or surface water. Naturally occurring soils have varying capacity to accomplish pollutant removal to protect the water resource. While many soil processes assist in wastewater treatment, three properties are recognized as the most important:

1) the depth of the soil to a limiting condition,
2) its permeability to air and water, and
3) aerobic (or unsaturated) conditions.

How does soil treat wastewater?

The structure, chemistry, and the biological activity in some soils make them ideal to treat wastewater to protect ground and surface water. The suspended solids, organic matter (measured as BOD_5), ammonia, bacteria, and viruses in wastewater can all be removed by an adequate layer of soil. Soil pores must be fine enough to trap suspended solids and disease-causing organisms. These same soils, however, must still have sufficient permeability to allow for the movement of air and water to accommodate the biological degradation of organic matter and ammonia by aerobic microorganisms that colonize the soil matrix. Finally, the soil must have the capability to adsorb viruses and other water pollutants, like phosphorus.

The **suspended solids** in wastewater give it a cloudy appearance. These small particles are easily filtered out through a layer of soil. After wastewater has flowed down through as little as 1 foot of unsaturated soil, it will be very clear and nearly free of suspended solids. While the wastewater at this point will look clean, it still contains dissolved pollutants and disease-causing organisms. This clear wastewater can still pollute ground or surface water. Therefore, a 1-foot-deep layer of soil is not enough to fully treat wastewater.

The **organic matter** dissolved in wastewater is an important source of food for microorganisms. That is why it is considered a water pollutant. The microorganisms in a stream or pond live and grow by consuming dissolved organic matter, utilizing the oxygen that fish and other aquatic organisms need, consequently stressing and even killing fish. Partially treated wastewater surfacing in a yard or discharged to a ditch may look clear, but when the little available oxygen is quickly consumed by microorganisms, the water soon becomes stagnant (or anaerobic) and will create strong odors and attract flies.

Fortunately, organic matter is a valuable soil constituent, not a soil pollutant. Soil structure, nutrient cycling, and biological activity benefit greatly from the addition of organic matter to soil. Naturally occurring microorganisms in the wastewater and the soil quickly colonize the surfaces of the soil particles when wastewater is applied through a septic system leach field. To remove nearly all of the organic matter, the wastewater must flow down through about 2 feet of unsaturated soil.

Ammonia is a very damaging water pollutant. Only small amounts of ammonia will kill fish and other aquatic organisms in a matter of minutes. Partially treated wastewater discharged to a ditch or field drainage tile that flows into a stream is very damaging to the environment.

Fortunately, in soil, ammonia can be rapidly converted to nitrate, a soil nutrient. Nitrogen is a necessary nutrient for the growth of plants. In fact, people frequently put ammonia fertilizer on their lawn or garden to increase plant growth. Ammonia is chemically attracted to soil particles and is converted to nitrate in the soil. Plants use the nitrate in the soil for growth. Naturally occurring microorganisms in the wastewater and soil that quickly colonize the surfaces of the soil particles also utilize ammonia as an important nutrient. Ammonia is mostly removed after the wastewater has flowed through about 2 feet of unsaturated soil.

Bacteria are present everywhere in the environment and most are helpful, not harmful. Unfortunately, human waste can contain disease-causing organisms that cause everything from diarrhea, chronic disease, and even death. That is why public health professionals are so careful to keep human waste from polluting drinking water, food, or even bodies of water where people of all ages may play, wade, swim, or fish. It is easy to forget that even partially treated sewage, while clear, discharged to a ditch in front of a home can threaten children that play, or touch pets that play, in the nearby yard.

Soil, however, is an excellent medium to remove bacteria from wastewater. Bacteria are both physically filtered out in the soil beneath a leach field or are chemically attracted to the surface of the soil particles (adsorbed). Once trapped in the soil, they either die in this now hostile environment or are preyed upon by other naturally occurring soil microorganisms.

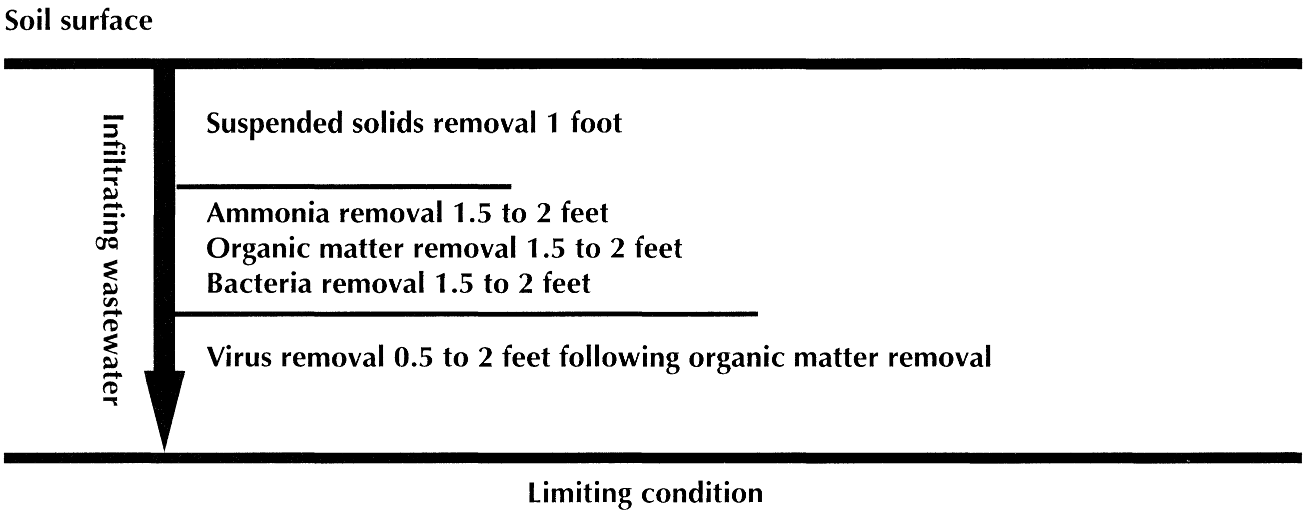
Researchers have found that fecal coliform bacteria were removed through an 18-inch deep column of unsaturated fine loamy soil. Bacteria were removed after moving downward through 24 inches of fine sandy loam. Therefore, by the treatment depth that the organic matter and suspended solids are removed, the bacteria are also removed.

Viruses in wastewater are different than bacteria and are removed by soil in a different way. Viruses are smaller than bacteria and actually consist of nucleic acid and protein molecules. Because they are so small they are rarely physically filtered out in the soil. They must be removed mostly by being chemically attracted (adsorbed) onto the surface of the soil particles. Another complication of virus removal is that organic matter in the wastewater interferes with the adsorption of viruses. Virus removal does not effectively occur until the organic matter has been removed in the first 2 feet of depth in the soil column. Researchers have found that viruses from sewage effluents were removed in soil columns ranging from 0.5 to 2 feet deep after the organic matter is removed.

Up to four feet of unsaturated soil is required underneath a soil absorption system and above a limiting condition to protect public health and the environment (Figure 1). Limiting conditions are considered to be soil or geologic layers that are either insufficiently or excessively permeable. In Ohio, limiting conditions include ground or perched water tables, hard, unfractured bedrock, dense glacial till, compacted zones, dense clays, pans such as fragipans, sand and gravel layers, fractured rock, and soil layers with large amounts of coarse fragments (stones).

Soil saturated with water does not remove pollutants from wastewater. Pollutants move with the water through the saturated soil only to travel into wells, streams, and ditches. Researchers have found viruses in wells 200 to 400 feet from the point where the viruses were introduced into saturated soils. Ammonia is not effectively utilized by plants and microorganisms in saturated soil. Ammonia moves with the water through the saturated soil, polluting streams and ponds.

Figure 1. Range of removal depths of pollutants in wastewater as infiltrating through unsaturated soil. Removal depth is influenced by soil permeability.



Which soil series are suited to septic system leach fields?

Septic system leach fields require deep, permeable soil to treat and safely dispose of wastewater. The Ohio Administrative Code (1977) requires a 4-foot-deep soil layer between the bottom of a sewage leaching trench and a limiting soil condition (Figure 2). If the trench bottom is 18 inches beneath the soil surface, a total of 5.5 feet of soil depth is required above a soil limiting condition of ground or perched water tables, hard, unfractured bedrock, dense glacial till, compacted zones, dense clays, pans such as fragipans, sand and gravel layers, and fractured rock.

Table 1 lists by name the soil series that are in the range of soil depths and permeabilities to be suited for septic system leach fields. The 84 soil series are present in 6.4% of Ohio's land area. Figure 3 shows where in Ohio these soil series are distributed. Remember, these soil series are used to describe soils over a range of depths. As shown in Figure 4 one of the soils listed ranges from 5 feet to 6 feet of depth above a limiting condition. Some of these depth differences are natural and some are the result of erosion and human activities. It is necessary to check the soil depth to a limiting condition in a soil pit before designing, building, or approving a septic system leach field.

Figure 2. Soil depth needed to site septic system leach field.

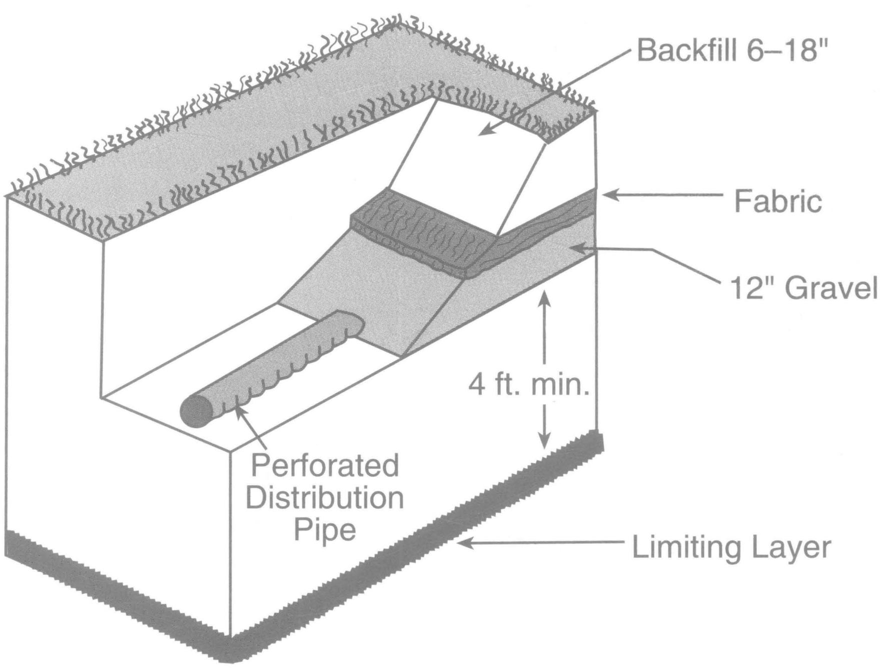


Table 1. Soil series suited for traditional leach line systems or mound systems.

Alford	Nineveh	**May be subject to flooding**
Allegheny	Oakville	Chagrin
Ashton	Ockley	Cuba
Beasley	Oshtemo	Genesee
Belmore	Otisville	Gessie
Birkbeck	Parke	Haymond
Bionnell	Pike	Jules
Boyer	Plattville	Landes
Brownsville	Princeton	Pope
Cedarfalls	Riddles	Ross
Chavies	Rigley	
Chenango	Rossburg	
Chili	Rush	
Cidermill	Russell	
Clymer	Saylesville	
Colonie	Scioto	
Conotton	Sewell	
Crider	Shelocta	
Donnelsville	Sisson	
Duncannon	Spargus	
Elkinsville	Sparta	
Frankstown	Spinks	
Fredricktown	Tyner	
Gallia	Uniontown	
Gallman	Watertown	
Grayford	Waupecan	
Hackers	Wea	
Hartshorn	Wellston	
Hayter	Westmore	
Hazelton	Westmoreland	
Hennepin	Wheeling	
Hickory	Williamburg	
Kanawha	Zurich	
Leoni		
Lumberton		
Lybrand		
Martinsville		
Mechanicsburg		
Mentor		
Mertz		
Negley		

Figure 3. Percent of soils by county suited to traditional leach lines or mound systems in Ohio.

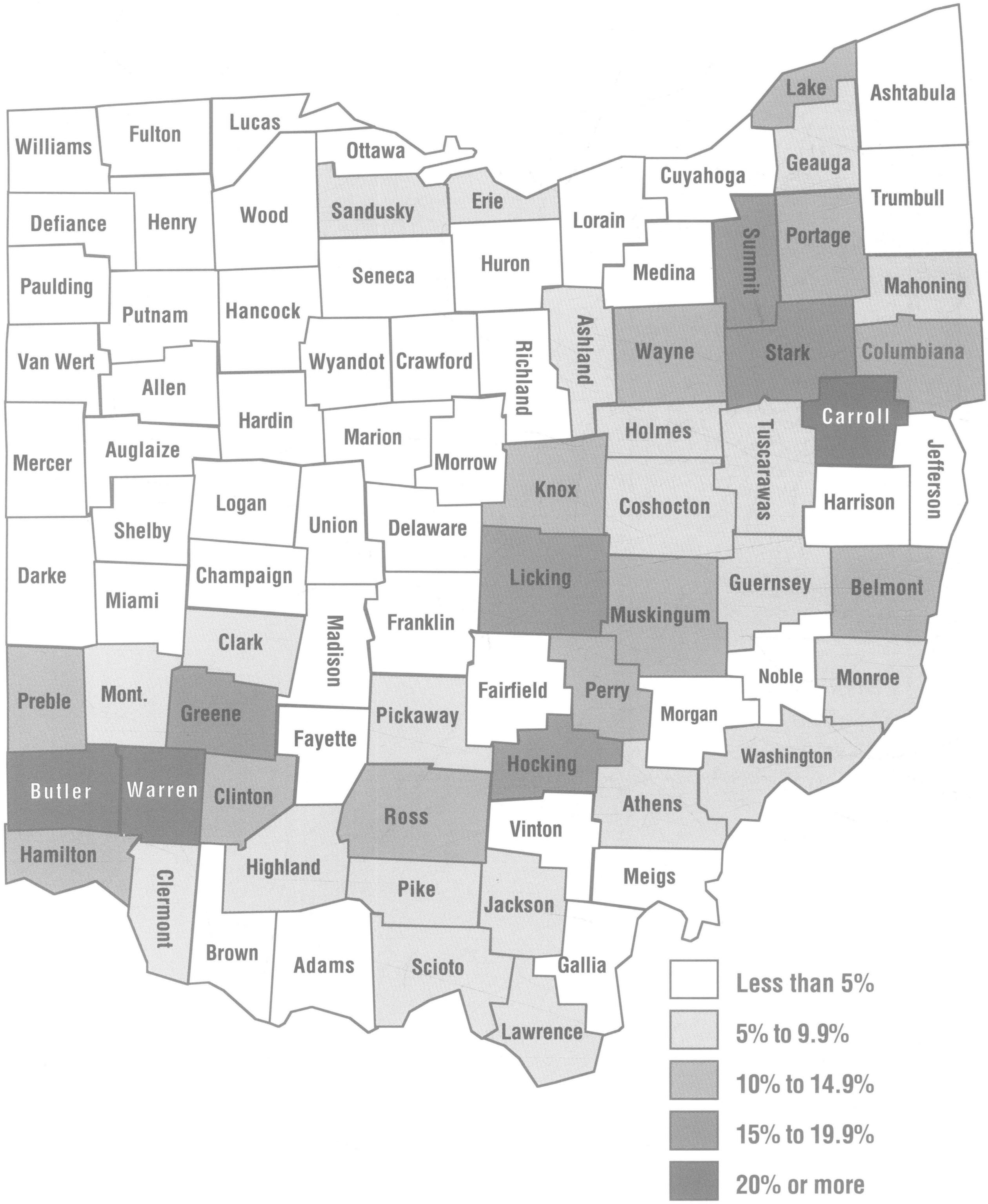
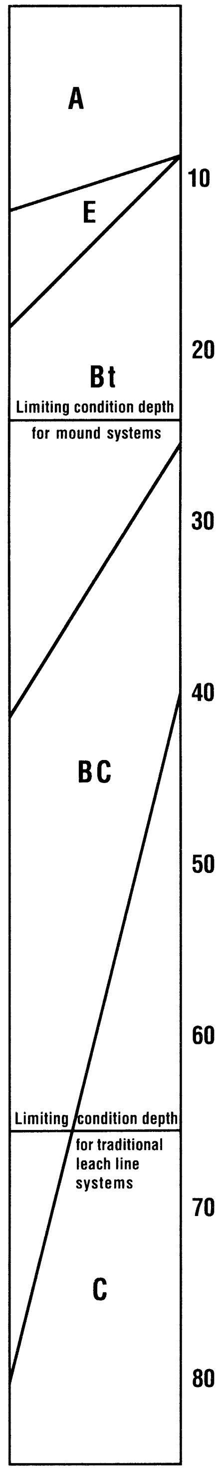


Figure 4. Soil suitable for traditional leach line system—Wheeling Series

a) Description of a single example profile:

Horizon	Depth Inches	Color	Texture	Structure	Consistence	Redox	Perm. In/hr
Ap	0-10	brown (10YR4/3)	silt loam	weak fine granular	friable		0.6-6
E	10-14	yellowish brown (10YR5/4)	silt loam	weak medium and fine subangular blocky	friable		0.6-6
Bt	14-34	dark yellowish brown (10YR4/4)	silty clay loam	moderate medium subangular or angular blocky	firm		0.6-2
BC	34-58	light yellowish brown (10YR6/4)	very fine sandy loam	weak coarse subangular blocky	firm		0.6-2
2BC2	58-60	dark brown (7.5YR4/2)	very gravelly sandy loam	very weak coarse subangular blocky	friable		0.6-2
3C	60-72	dark grayish brown (10YR4/2)	stratified very gravelly sand				6-20

b) Composite profile showing common range of depths for horizons



What if the soil is too shallow for a leach field?

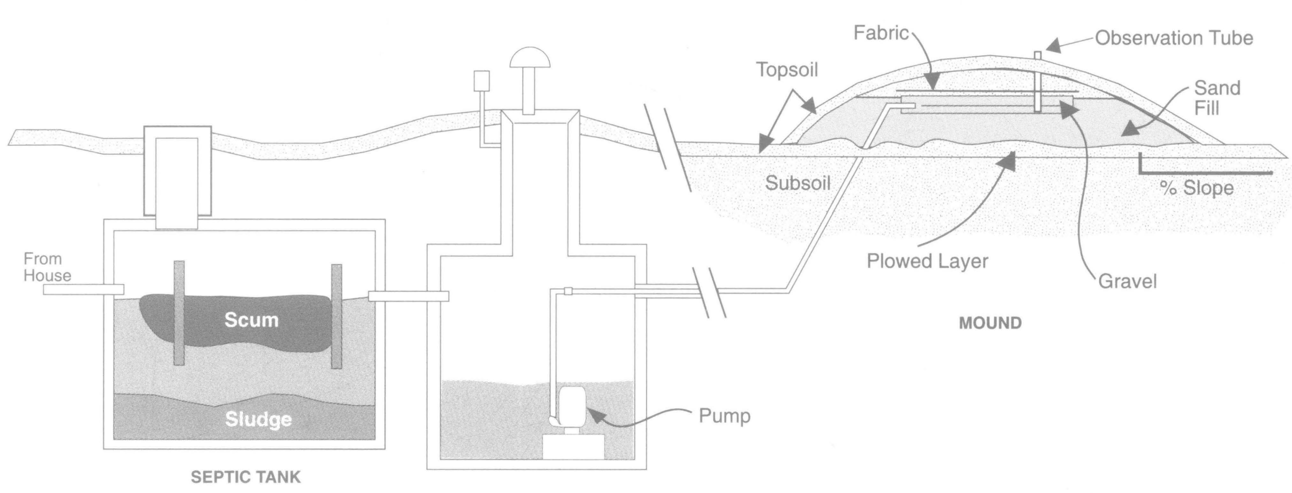
In most of Ohio, the soil is too shallow to construct a septic system leach field. Many people try to construct a septic system leach field anyway. These systems fail within months, creating a public health and environmental hazard. Untreated sewage either comes to the surface in the yard or moves through saturated soil to pollute nearby wells and groundwater.

To keep sewage from surfacing in lawns, some systems are installed with shallow curtain drains placed about 26 inches beneath the soil surface about 8 feet from the leach field. These curtain drains carry pollutants away from the home, but discharge pollutants directly into streams or into ditches or agricultural drainage systems that drain into streams. Shallow curtain drains that intersect untreated wastewater are an important source of nonpoint source pollution in Ohio and should never be used.

Sand has been shown by researchers at Ohio State University to be a medium to aid in wastewater treatment. Organic matter (BOD_5), total suspended solids, and ammonia is removed from septic tank effluent through a 2-foot layer of specially sized sand. The sand does not, however, do the entire job. Sand does a poor job of removing all of the disease-causing bacteria and viruses from wastewater. Sand does not have the same chemical or physical properties as natural soil and has limited capacity to attract bacteria and viruses to adhere (adsorb) onto particle surfaces. If sand is used to remove organic matter, suspended solids, and ammonia, a second treatment step is needed to remove the disease-causing organisms.

In 1978, Dr. Converse of the University of Wisconsin presented an onsite wastewater treatment system design that could be used in areas with shallow soil depths to a limiting condition. Known as a mound system, a layer of sand is placed on top of the natural soil to augment its treatment capacity as shown in Figure 5. The sand layer of up to 2 feet acts to reduce suspended solids, organic matter, and ammonia with continued removal, along with bacteria and virus removal in the underlying soil. Dr. Converse found that with sand augmentation, onsite wastewater treatment systems could be used in areas with more slowly permeable soils, with permeabilities as low as 0.5 inches per hour. Ohio State University Extension Bulletin 813 adapted the concept of a mound presented by Drs. Converse and Tyler for Ohio's soil conditions and regulatory requirements.

Figure 5. Cross section of mound system.



Which soil series are suited to mound systems?

Mound systems require at least 2 feet of permeable soil to finish treating and safely dispose of sand-treated wastewater. Ohio State University Extension Bulletin 813 recommends a 2-foot-deep soil layer between the soil surface and a limiting soil condition. A soil limiting condition includes ground or perched water tables, hard, unfractured bedrock, dense glacial till, compacted zones, dense clays, pans such as fragipans, sand and gravel layers, and fractured rock.

Do not confuse mound systems designed for wastewater treatment and disposal through soil absorption with systems sometimes called ET mounds. ET stands for evapotranspiration. For ET systems some small mounds of soil or fill material are constructed to accept septic tank effluent. The designers and builder mistakenly believe that trees planted on the top of these mounds of soil will take up the water year-round and the wastewater will simply go away. In Ohio, however, we are blessed with abundant rainfall. More water, in fact, falls to the earth as precipitation in Ohio than is transpired by plants. That is why Ohio has beautiful streams and wetlands. These evapotranspiration systems are quickly overloaded in Ohio, leaching out on the lot and creating a lush green spot and eventually a soft, wet, smelly area in the lawn. To keep this from happening, drains are sometimes installed around the ET system, carrying the overflow of untreated wastewater with its pollutants to a nearby ditch or stream by a buried drainage pipe. One sure sign of how these systems are overwhelmed with water is when the trees quickly die. Trees need aerobic soil to live, and they die in soil saturated with water.

Table 2 lists by name the soil series with properties that are in the range of soil depths and permeabilities considered suitable for mound systems. The 168 soil series are present in 25.4% of Ohio's land area. Figure 6 shows where in Ohio these soil series are distributed. Remember, these soils series are used to describe soils over a range of depths. As shown in Figure 7 one of the soils listed ranges from 1.5 feet to 5 feet of depth above a limiting condition. Some of these depth differences are natural and some are the result of erosion and human activities. It is necessary to check the soil depth to a limiting condition in a soil pit before designing, building, or approving a mound system.

Table 2. Soil series suited for mound systems only.

Aaron	Digby	Loudonville	Sleeth	**May be subject to flooding**
Alexandria	Dunbridge	Lowell	St.Clair	
Amanda	Edenton	Lykens	Steinsburg	Lobdell
Ava	Elba	Markland	Stringley	Medway
Bepre	Eldean	Miami	Summitville	Nolin
Berks	Elliott	Miamian	Switzerland	Sligo
Bixler	Ellsworth	Milton	Tarhollow	Tioga
Blairton	Ernest	Mitiwanga	Tarlton	
Bogart	Faywood	Monongahelia	Teegarden	
Boston	Fincastle	Morley	Tilsit	
Braceville	Fitchville	Morrisville	Tippecanoe	
Brady	Fox	Muse	Tiro	
Bratton	Gallipolis	Muskingum	Trappist	
Brecksville	Geeburg	Nicholson	Tremont	
Brenton	Germano	Odell	Tuscola	
Bronson	Gilpin	Ogontz	Upshur	
Brooke	Glenford	Omulga	Vandalia	
Brookside	Gosport	Ottokee	Vandergrift	
Broughton	Guernsey	Otwell	Vaughnsville	
Brushcreek	Haney	Pacer	Wakeman	
Cambridge	Hanover	Parr	Warsaw	
Cana	Harbor	Perrin	Waynetown	
Caneadea	Heverlo	Pierpont	Weinbach	
Canfield	Homer	Pinegrove	Wernock	
Captina	Homewood	Plainfield	Westgate	
Cardinal	Ionia	Plumbbrook	Wharton	
Casco	Iva	Prout	Whitaker	
Castalia	Jeneva	Rainsboro	Woodsfield	
Celina	Jessup	Raub	Woolper	
Centerburg	Jimtown	Rawson	Wooster	
Cincinnati	Johnsburg	Reesville	Wyatt	
Clarksburg	Kane	Richland	Wynn	
Coblen	Keene	Rittman	Xenia	
Corwin	Kelloggs	Rodman	Zanesville	
Coshocton	Kendallville	Rossmoyne		
Crane	Kensington	Sardinia		
Cruze	Ladig	Savona		
Culleoka	Lakin	Schaffenaker		
Cygnet	Libre	Sciotoville		
Dana	Licking	Sees		
Darroch	Lily	Seward		
Dekalb	Lordstown	Shawtown		
DelRay	Loudon	Shinrock		

Figure 6. Percent of soils by county suited to mound systems only in Ohio.

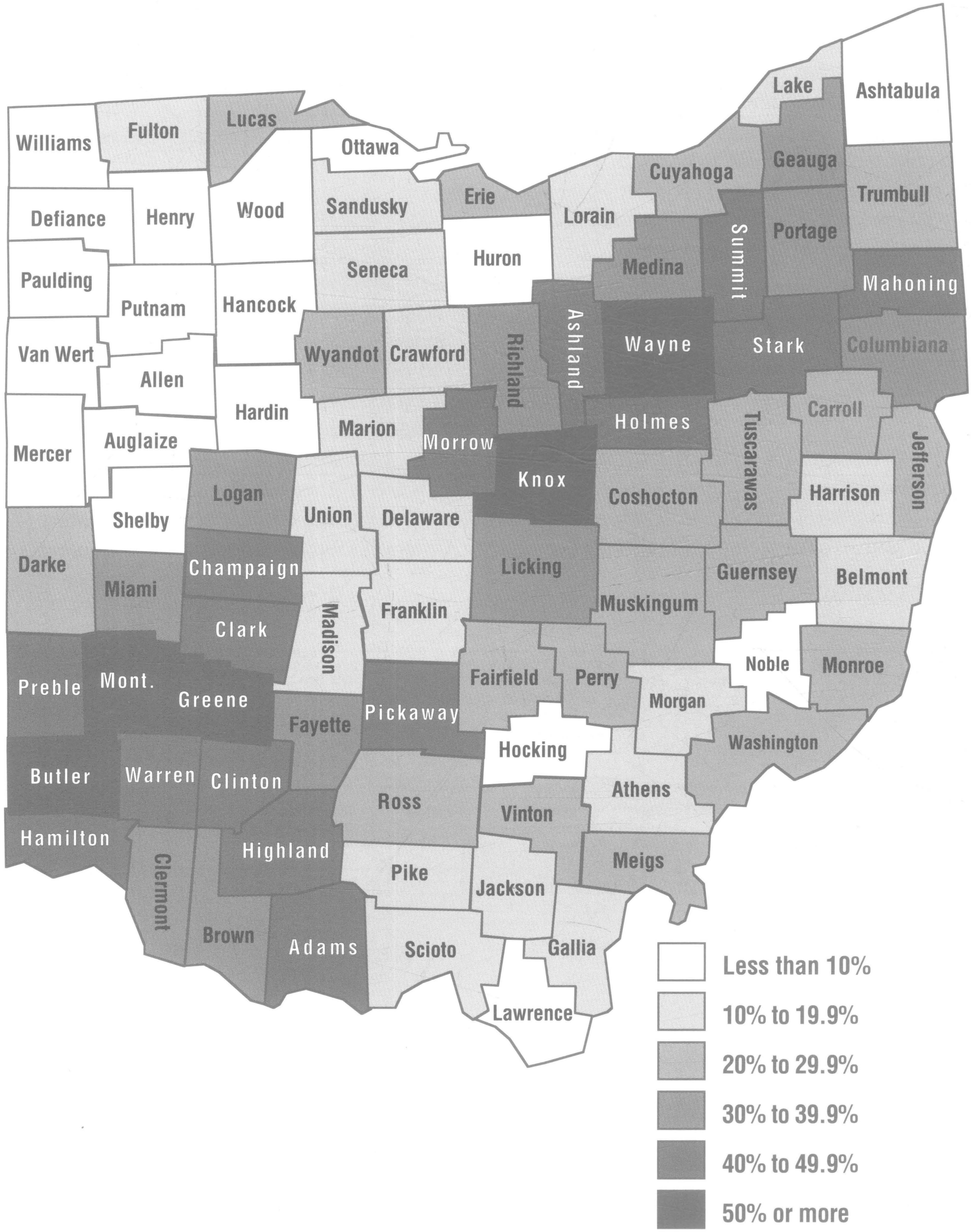
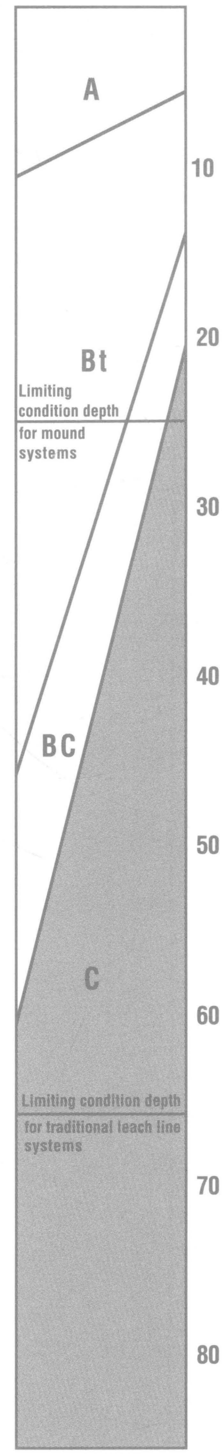


Figure 7. Soil suitable for mound systems—Miamian Series

a) Description of a single example profile:

Horizon	Depth Inches	Color	Texture	Structure	Consistence	Redox	Perm. In/hr
Ap	0-9	brown (10YR4/3)	silt loam	moderate medium subangular blocky parting to weak fine granular	friable		0.2-0.6
Bt1	9-12	dark yellowish brown (10YR4/4)	clay loam	moderate medium subangular blocky	friable		0.2-0.6
Bt2	12-18	dark yellowish brown (10YR4/4)	clay loam	moderate medium subangular or angular blocky	firm		0.2-0.6
Bt3	18-26	yellowish brown (10YR5/4)	clay	weak medium prismatic parting to strong medium subangular and angular blocky	firm		0.2-0.6
BCt	26-33	yellowish brown (7.5YR4/2)	loam	weak coarse subangular blocky	firm	few fine prominent strong brown (7.5YR5/8) iron accumulations	0.2-0.6
Cd	33-80	yellowish brown (10YR5/4)	loam	massive	very firm	few prominent strong brown accumulations	0.2-0.6

b) Composite profile showing common range of depths for horizons



What if the soil is too shallow for a mound system?

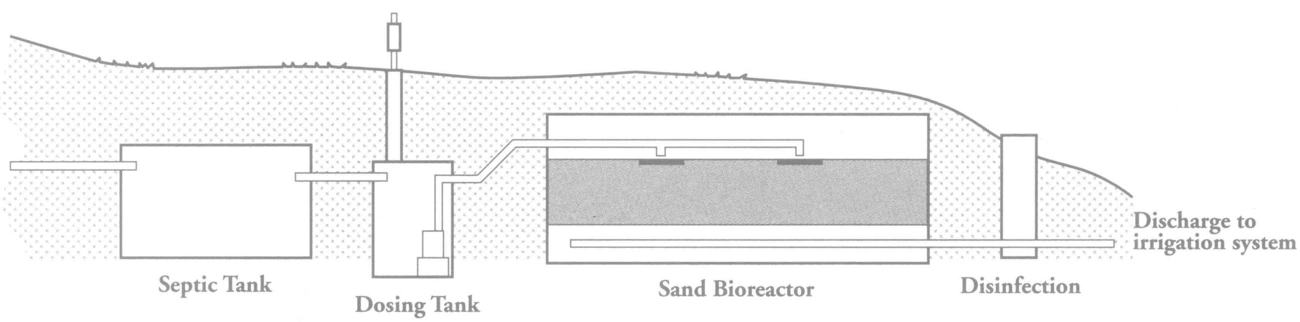
Most of Ohio's soil natural resource is too shallow to use for wastewater treatment. For homes built in areas with these soils, septic system leach fields and mound systems will not work. If designed, constructed, and approved anyway, they will threaten public health and the environment. For these situations a separate wastewater treatment system must be constructed to remove ammonia, organic matter, suspended solids, bacteria, and viruses.

As noted with mound systems, sand does an excellent job of removing ammonia, organic matter, and suspended solids from wastewater. In areas with very shallow soils above a limiting condition, sealed basins or tanks of sand can be carefully constructed to accept septic tank effluent and partially treat the wastewater (Figure 8). Known as sand bioreactors, or sometimes called sand filters, these treatment systems can be constructed right on the lot. Bulletin 876, *Sand Bioreactors for Wastewater Treatment in Ohio*, gives all of the details to design and construct these sand treatment systems.

Sand, however, does a poor job of removing disease-causing organisms from wastewater. A separate disinfection unit is needed to remove bacteria and viruses from sand-filtered wastewater. Bulletin 876 also presents the options for disinfection.

Once treated and disinfected, wastewater must be released back into the environment. Remember, treated wastewater is not pure water, and will still contain low levels of water pollutants. The soil, once again, is a wonderful place to disperse the treated wastewater because the water pollutants of organic matter and ammonia are converted to useful constituents in soil.

Figure 8. Watertight basin for sand bioreactor followed by disinfection system.



Which soil series are suited to soil dispersal of treated wastewater?

To maintain a healthy environment for plant growth, plants need aerobic soil. Therefore, the application of treated wastewater must be carefully considered to keep the soil from getting too wet, even in a wetter than average year. Ohio State University Extension Bulletin 860, *Reuse of Reclaimed Wastewater Through Irrigation*, recommends a 1-foot-deep soil layer between the soil surface and a limiting soil condition. A soil limiting condition includes ground or perched water tables, hard, unfractured bedrock, dense glacial till, compacted zones, dense clays, pans such as fragipans, sand and gravel layers, and fractured rock.

Soil dispersal uses irrigation systems to apply a shallow depth of wastewater with each application. For onsite systems, this should never exceed 1 inch per week for normal lawn and landscaping applications. Do not confuse irrigation systems designed for wastewater dispersal with swale or wetland systems that concentrate several inches of water in a small area. Saturated soils can only support a limited variety of wetland plants. Cattails, for example, are a sure sign of wet, saturated soil.

Table 3 lists by name the soil series that are in the range of soil depths and permeabilities to be suited for dispersal systems. The 123 soil series are present in 49% of Ohio's land area. Remember, these soils series are used to describe soils over a range of depths. As shown in Figures 9 and 10 two of the soils listed range from 8 inches to 20 inches of depth above a limiting condition. Some of these depth differences are natural and some are the result of erosion and human activities. It is necessary to check the soil depth to a limiting condition in a soil pit before designing, building, or approving a soil dispersal system.

Table 3. Soil series not suited for soil-based wastewater treatment, but may be suited for irrigation of treated wastewater.

Shallow depth to restrictive layer	Shallow depth to water table		May be subject to flooding
Bethesda	Aetna	Mahoning	Clifty
Biglick	Algansee	McGary	Flatrock
Channahon	Algiers	Mespo	Harrod
Colyer	Atlas	Metamora	Hartshorn
Enoch	Aurand	Minoa	Huntington
Fairmount	Avonburg	Mortimer	Kinn
Fairpoint	Bennington	Nappanee	Knoxdale
Farmerstown	Blount	Newark	Lanier
Gasconade	Canal	Painesville	Lindside
Lewisburg	Cardington	Pekin	Moshannon
Lorenzo	Cavode	Platea	Orrville
Marblehead	Ceresco	Pyront	Philo
Morristown	Claverack	Randolph	Sarahsville
Opequon	Claysville	Rarden	Senecaville
Richey	Coolville	Ravenna	Skidmore
Strawn	Crosby	Red Hook	Stonelick
Titusville	Crosier	Remsen	
Tuscarawas	Darien	Rimer	
Weikert	Defiance	Schaffer	
	Dixboro	Shoals	
Very slowly permeable	Doles	Smothers	
Eden	Dubois	Stafford	
Lawshe	Eel	Stanhope	
Lucas	Elnora	Stendal	
Pate	Fulton	Stone	
Roselms	Galen	Taggart	
	Gavers	Tedrow	
	Glynwood	Thackery	
	Gresham	Thrifton	
	Haskins	Tiderishi	
	Haubstadt	Tygart	
	Henshaw	Tyler	
	Holton	Vanlue	
	Hornell	Venango	
	Houcktown	Wadsworth	
	Hyatts	Wakeland	
	Jenera	Wallington	
	Jonesboro	Waphani	
	Kibbie	Westboro	
	Lamberjack	Wilbur	
	Latham	Williamson	
	Lockport		

Figure 9. Soil suitable for dispersal—Crosby Series

a) Description of a single example profile:

Horizon	Depth Inches	Color	Texture	Structure	Consistence	Redox	Perm. In/hr
Ap	0-8	dark grayish brown (10YR4/2)	silt loam	moderate medium granular	friable		0.6-2
BE	8-11	grayish brown (10YR4/4)	silt loam	moderate thin platey	friable	few fine distinct grayish brown iron oxide masses	0.6-2
Bt1	11-14	brown (10YR5/3)	silt loam	moderate medium subangular or angular blocky	firm	many medium distinct gray (10YR6/1) iron depletions and yellowish brown (10YR5/6) iron oxide masses	0.6-2
2Bt2	14-22	brown (10YR5/3)	silty clay loam	moderate medium subangular and angular blocky	firm	many medium distinct gray (10YR6/1) iron depletions and yellowish brown (10YR5/6) iron oxide masses	0.6-2
2Bt3	22-28	yellowish brown (10YR5/4)	clay loam	weak medium subangular blocky	firm	many medium distinct yellowish brown (10YR5/6) and strong brown (7.5YR5/8) iron oxide masses	0.6-2
2BCt	28-36	brown (10YR5/3)	loam	weak coarse subangular blocky	firm	common fine distinct yellowish brown (10YR5/6) and fine faint yellowish brown accumulations	0.06-0.2
2Cd	36-80	brown	loam	weak coarse subangular blocky	firm	common fine distinct yellowish brown and faint yellowish brown accumulations	0.01-0.2

b) Composite profile showing common range of depths for horizons

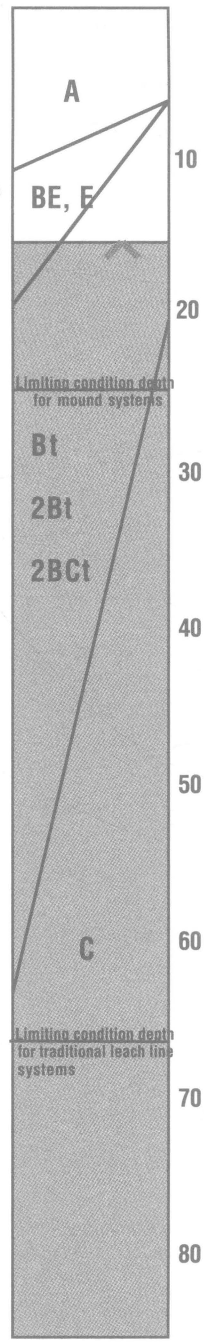
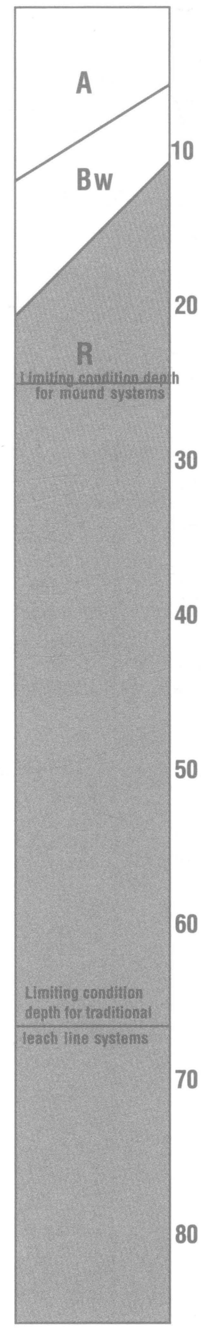


Figure 10. Soil suitable for dispersal—Fairmount Series

a) Description of a single example profile:

Horizon	Depth Inches	Color	Texture	Structure	Consistence	Redox	Perm. In/hr
Ap	0-11	dark brown (10YR3/2)	flaggy silty clay	moderate fine angular blocky	firm		0.06-0.6
Bw	11-17	brown (10YR4/3)	flaggy clay	moderate fine and medium angular blocky	very firm		0.06-0.6
R	17+	hard gray limestone					0-0.06

b) Composite profile showing common range of depths for horizons



What if the soil is too shallow for soil dispersal of treated wastewater?

The Ohio soil resource includes a number of wet, seasonally saturated soils.These soils, saturated for several months most years within 1 foot of the ground surface, are important to Ohio's natural environment.These soils provide habitat for wildlife and wetland plants.They buffer the movement of water through the landscape to mediate flooding, and they slow down the movement of water to reduce the amount of soil that can erode into Ohio's streams and lakes.

These wonderful soils, however are not at all suited to home construction and also are not suited to the onsite treatment and disposal of wastewater.Any homes or structures that absolutely must be built in these types of soils will require a sewer system to transport the wastewater to a location where it can be treated and safely disposed of. It is important for designers, planners, installers, and regulators to recognize these valuable soils and protect them from inappropriate construction.

Which soil series are wet, seasonally saturated?

Table 4 lists by name the soil series that are in the range of soil depths and permeabilities to be unsuited for dispersal systems.The 92 soil series are present in 19% of Ohio's land area. These soils are saturated with water within 1 foot of the ground surface for several months in most years. One of these soils is presented in Figure 11. In some of these soils the water rises above the surface of the ground.Wetland plants, like cattails, are good indicators of these seasonally saturated soils. It may be necessary to check the soil depth to a limiting condition in a soil pit before designing, building, or approving a wastewater treatment system.

Table 4. Wet, seasonally saturated (hydric) soils that are not suited to onsite wastewater treatment.

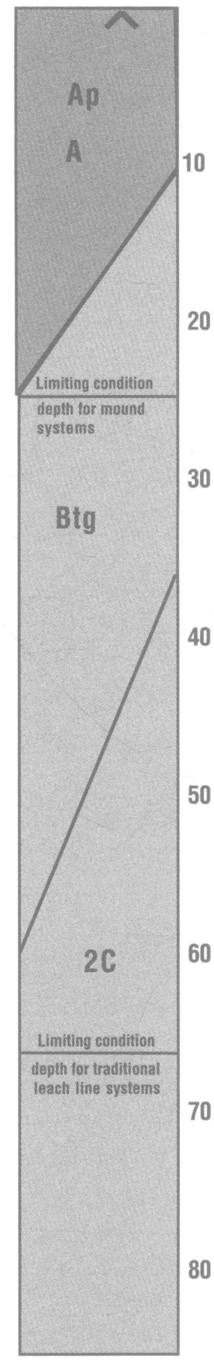
Adrian	Mermill
Allis	Milford
Alvada	Millgrove
Atherton	Milldale
Beaucoup	Miner
Blanchester	Montgomery
Bonnie	Muskego
Bono	Olentangy
Brookston	Olmsted
Canadice	Pandora
Carlisle	Patton
Clermont	Paulding
Cohoctah	Peoga
Colowood	Pewamo
Condit	Pinnebog
Conneaut	Piopolis
Damascus	Purdy
Drummer	Ragsdale
Edwards	Rensselaer
Frenchtown	Risingsun
Fries	Rockmill
Gilford	Rollersville
Ginat	Romeo
Glendora	Roundhead
Granby	Sandusky
Holly	Saranac
Hoytville	Sebring
Ilion	Secondcreek
Joliet	Sheffield
Kerston	Sloan
Killbuck	Swanton
Kingville	Tawas
Kokomo	Toledo
Kyger	Treaty
Lamson	Trumbull
Latty	Wabasha
Lenawee	Wallkill
Linwood	Warners
Lippincott	Washtenaw
Lorain	Wauseon
Luray	Wayland
Mahalasville	Westland
Marengo	Wetzel
Martinisco	Weyers
McGuffey	Willette
Melvin	Zipp

Figure 11. Soil unsuitable for waste application—Kokomo Series

a) Description of a single example profile:

Horizon	Depth Inches	Color	Texture	Structure	Consistence	Redox	Perm. In/hr
Ap	0-9	very dark gray (10YR3/1)	silty clay loam	weak fine and medium granular	friable		0.6-2
A	9-16	black (10YR2/1)	silty clay loam	moderate fine and medium angular blocky	firm		0.6-2
Btg1	16-31	dark gray (5YR4/1)	silty clay loam	moderate medium and fine subangular and angular blocky	firm	common medium distinct dark yellowish brown (10YR 4/4) and few medium prominent yellowish brown (10YR 5/6) iron oxide masses	0.2-0.6
Btg2	31-50	olive gray (5Y 5/2)	silty clay loam	moderate coarse subangular blocky	firm	common coarse prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/8) iron oxide masses	0.2-0.6
2C	50-64	brown (10YR 5/3)	loam	massive	friable		0.2-0.6

b) Composite profile showing common range of depths for horizons



Finding information on soil characteristics

A comprehensive program to describe, classify, map, and interpret Ohio's soils began in 1899. The program has involved cooperation between the United States Department of Agriculture—Soil Conservation Service (now the Natural Resources Conservation Service), together with state agencies and The Ohio State University. Soil survey information is available for all 88 Ohio counties. Each soil is described in terms of sequences of layers, called horizons, that have developed through time from a variety of parent materials, under the influence of climate, living organisms, and the position of the soil on the landscape. Each soil horizon and each integrated soil profile presents a unique set of conditions for effluent treatment.

For planning purposes, each county soil survey contains a table listing the acreage and proportionate extent of the soils in that county. All 88 tables were reviewed to determine the extent of each soil category by county. These figures are presented by county in Appendix 1.

Remember, statewide only 6.4% of the land area is suited for soil absorption systems using traditional leach lines. This amounts to about 1,680,020 acres of land. Soil series suited for mound systems are present in 25.4% of Ohio's land area accounting for 6,667,579 acres of land. Soil absorption systems and mound systems are important tools in enabling homes to be built beyond the reach of sewer systems while still protecting the public health and the environment. Care in evaluating sites must be practiced to ensure that ground and surface waters are not contaminated and that untreated sewage does not surface in yards or seep into ditches.

Soil maps, while important useful tools, do not guarantee the presence of the soil series mapped at every spot identified. Soil maps indicate the predominant soil type in an area. Small inclusions of contrasting soils are often present within mapping units. Also many soils throughout Ohio have been disturbed and eroded. Individual site assessment to determine suitability is always necessary before designing and constructing a soil absorption system or mound.

Ohio soils well-suited for traditional leach lines are rare and valuable, because of their ability to easily and inexpensively renovate sewage to protect ground and surface water. These deep, well-drained soils are also valuable agricultural soils and are well suited for construction projects. The most highly settled areas of Ohio also have the largest acreages of deep, well-drained soils. Much of this soil has already been disturbed. The remaining areas should be identified and protected from damage caused by construction, excavation, or filling. It has taken natural processes thousands of years to create these soils. They can be quickly destroyed if not recognized and protected.

As Ohio communities begin to plan for the future, they need to consider how best to provide sewage treatment services. Through careful use of soil-based sewage treatment and disposal systems, homes can be constructed in rural Ohio while still protecting the public health and Ohio's valuable water resources.

For more information

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National Cooperative Soil Survey. 1960–2000. Soil surveys for counties in Ohio. 88 different volumes with one for each Ohio county. Can be obtained through the Soil and Water Conservation District office in each county.

Ohio Administrative Code. 1977. Chapter 3701-29.

Widrig, D., and K. Mancl. 1990. Mound systems for on-site wastewater treatment … siting, design and construction in Ohio. Ohio State University Extension Bulletin 813. Columbus, OH. 20 pages.

Appendix 1. Percent of soils in onsite wastewater treatment suitability categories for all 88 Ohio counties.

		% of soils suitable			
County	Acres in county	Traditional leach lines or mound system	Mound system only	Onsite treatment with irrigation	Not suited for onsite systems (hydric)
Adams	375,872	4.20%	40.40%	54.80%	0.60%
Allen	262,400	4.40%	9.70%	51.10%	34.80%
Ashland	271,104	7.20%	40.90%	46.50%	5.40%
Ashtabula	451,340	4.40%	4.30%	44.60%	46.70%
Athens	322,560	6.60%	12.90%	78.30%	2.20%
Auglaize	255,936	1.40%	7.90%	64.70%	26.00%
Belmont	341,952	13.30%	13.60%	72.70%	0.40%
Brown	313,856	3.40%	32.70%	40.90%	23.00%
Butler	301,184	23.90%	55.20%	18.20%	2.70%
Carroll	249,856	25.20%	22.30%	49.20%	3.30%
Champaign	277,120	1.90%	45.20%	29.10%	23.80%
Clark	256,883	5.20%	45.30%	25.50%	24.00%
Clermont	293,760	5.30%	38.80%	40.20%	15.70%
Clinton	263,680	11.80%	40.30%	25.10%	22.80%
Columbiana	342,400	14.20%	39.40%	39.80%	6.60%
Coshocton	362,728	7.60%	25.30%	65.70%	1.40%
Crawford	258,560	1.10%	19.30%	50.00%	29.60%
Cuyahoga	291,840	4.70%	23.70%	66.50%	5.10%
Darke	387,136	0.40%	21.10%	51.40%	27.10%
Defiance	263,680	2.60%	4.80%	36.60%	56.00%
Delaware	281,600	2.00%	19.70%	58.30%	20.00%
Erie	168,960	6.70%	24.70%	37.30%	31.30%
Fairfield	323,200	3.60%	27.00%	55.60%	13.80%
Fayette	259,840	0.80%	37.00%	22.30%	39.90%
Franklin	344,064	3.80%	18.10%	62.10%	16.00%
Fulton	260,288	3.60%	15.30%	34.00%	47.10%
Gallia	301,440	3.30%	13.30%	82.70%	0.70%
Geauga	260,480	5.50%	33.40%	53.20%	7.90%
Greene	265,792	15.60%	50.40%	10.10%	23.90%
Guernsey	332,170	5.70%	23.00%	51.30%	20.00%
Hamilton	265,152	13.80%	46.70%	39.20%	0.30%
Hancock	340,480	0.90%	7.10%	48.10%	43.90%
Hardin	301,472	0.60%	2.80%	60.20%	36.40%
Harrison	262,800	0.10%	15.70%	83.30%	0.90%
Henry	266,240	1.00%	5.30%	17.90%	75.80%
Highland	351,360	6.00%	45.20%	36.20%	12.60%
Hocking	269,440	17.60%	7.60%	74.70%	0.10%
Holmes	271,600	8.60%	47.60%	41.10%	2.70%
Huron	317,517	4.10%	7.20%	72.30%	16.40%
Jackson	268,256	7.80%	14.00%	74.80%	3.40%
Jefferson	262,848	1.10%	25.00%	73.70%	0.20%
Knox	339,904	12.20%	57.20%	24.60%	6.00%
Lake	148,032	11.20%	11.80%	58.50%	18.50%
Lawrence	291,520	8.70%	6.40%	84.60%	0.30%

County	Acres in county	% of soils suitable: Traditional leach lines or mound system	Mound system only	Onsite treatment with irrigation	Not suited for onsite systems (hydric)
Licking	438,976	16.30%	38.20%	33.80%	11.70%
Logan	294,464	1.70%	35.00%	39.60%	23.70%
Lorain	316,800	3.10%	17.20%	58.00%	21.70%
Lucas	219,776	4.20%	22.10%	29.50%	44.20%
Madison	296,320	0.40%	16.10%	45.30%	38.20%
Mahoning	268,160	6.20%	43.10%	32.80%	17.90%
Marion	259,072	1.10%	10.70%	47.60%	40.60%
Medina	271,744	2.80%	33.70%	57.10%	6.40%
Meigs	278,720	2.60%	23.80%	73.40%	0.20%
Mercer	284,160	1.00%	1.90%	64.20%	32.90%
Miami	260,352	3.60%	34.80%	44.60%	17.00%
Monroe	291,200	6.50%	23.70%	69.80%	0.00%
Montgomery	297,600	7.80%	58.90%	17.50%	15.80%
Morgan	269,888	1.60%	18.70%	79.40%	0.30%
Morrow	258,112	3.10%	49.20%	34.50%	13.20%
Muskingum	416,640	11.10%	29.80%	57.00%	2.10%
Noble	254,976	1.10%	9.60%	85.10%	4.20%
Ottawa	172,160	0.20%	7.40%	37.70%	54.70%
Paulding	266,240	0.40%	1.10%	29.90%	68.60%
Perry	262,080	13.90%	29.90%	51.90%	4.30%
Pickaway	322,560	7.00%	45.50%	26.20%	21.30%
Pike	283,648	5.20%	15.30%	78.40%	1.10%
Portage	316,544	12.30%	30.70%	40.00%	17.00%
Preble	273,920	10.50%	47.40%	23.00%	19.10%
Putnam	311,040	1.10%	7.00%	19.00%	72.90%
Richland	318,080	3.90%	38.20%	46.80%	11.10%
Ross	439,680	13.20%	28.80%	52.50%	5.50%
Sandusky	261,888	6.10%	12.30%	32.80%	48.80%
Scioto	389,184	7.70%	17.50%	74.40%	0.40%
Seneca	352,640	4.30%	15.20%	55.50%	25.00%
Shelby	261,056	0.50%	5.90%	72.30%	21.30%
Stark	366,720	19.60%	40.00%	30.30%	10.10%
Summit	264,320	18.90%	45.90%	33.90%	1.30%
Trumbull	389,120	4.30%	29.50%	52.80%	13.40%
Tuscarawas	364,160	9.80%	25.30%	63.70%	1.20%
Union	277,760	1.40%	14.20%	54.20%	30.20%
VanWert	261,760	0.40%	3.60%	27.40%	68.60%
Vinton	265,548	1.00%	20.00%	78.40%	0.60%
Warren	261,120	20.70%	42.00%	23.40%	13.90%
Washington	410,240	7.40%	26.20%	66.20%	0.20%
Wayne	358,912	10.30%	56.30%	25.60%	7.80%
Williams	269,312	3.10%	9.40%	60.30%	27.20%
Wood	395,520	0.70%	5.10%	16.70%	77.50%
Wyandot	259,840	3.60%	21.10%	44.00%	31.30%
Statewide		6.40%	25.40%	49.10%	19.10%

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